P259

P259 -MEASURING PRESSURE WAVES IN DIALYSIS LINES TO DERIVE CONTINUOUS ARTERIAL BLOOD PRESSURE: PILOT WORK IN AN IN VITRO AND IN SILICO MODEL.

Professor Paul Stewart[3], Professor Jill Stewart[3], Mr T Walker[3], Dr V R Latha Gullapudi[1,2], Dr Nicolas M Selby[1,2], Professor Maarten W Taal[1,2]

[1]University Of Nottingham, Derby, United Kingdom, [2]Royal Derby Hospital, Derby, United Kingdom, [3]University of Derby, Derby, United Kingdom

Introduction:
Intradialytic hypotension remains a common and harmful complication of dialysis. Standard arm-cuff blood pressure measurements are taken infrequently and do not allow reliable prediction of events. Continuous non-invasive blood pressure measurement may allow the construction of models to predict haemodynamic instability, but current methods are sensitive to patient movement disturbances and are uncomfortable for patients to wear. We have developed a prototype by which pressure sensors in dialysis lines can be used to reconstruct arterial blood pressure and record it continuously, operating at a sufficient sampling rate and with robustness to patient movements. We then test this in an in vitro model, both with and without the pressure disturbances from the peristaltic blood pump of the dialysis machine.
Methods:
Standard low-cost industrial process control pressure sensors with on-board signal amplification and linearization have been developed with connectors to fit ports on standard dialysis lines. We have tested this by connecting the dialysis circuit to a laboratory simulated cardiovascular system which replicates arterial pressure waveforms using pre-recorded patient data, or arbitrary 'synthetic' waveforms. A Hospal Integra dialysis machine has been adapted to allow computer control of the peristaltic pump speed. Actual arterial pressure in the cardiovascular simulator is available from a dedicated pressure sensor. Experiments have been conducted to collect data across a representative set of pressure waveforms and pump speeds. Artificial Intelligence is applied to learn the physical dynamics of pressure waveforms in the arterial and venous dialysis lines. A novel Fourier Series real-time filter is applied to the line pressure data to reconstruct the arterial waveform.
Results:
We show that a reliable pressure wave form can be detected by pressure sensors in the arterial and venous dialysis lines. A method to self-calibrate across needle/sensor/line/sensor position variables is demonstrated. Additionally a mathematical transform and filter method successfully reconstructs the arterial blood pressure waveform (figure 1). The waveform can be maintained even in the presence of significant disturbance waveforms from the dialyser peristaltic pump.
Conclusions:
A low cost, non-invasive method of reconstructing continuous real-time blood pressure waveforms and associated haemodynamics which is robust to external disturbance offers the opportunity for continuous intradialytic monitoring and provides a foundation for future development of haemodynamic instability prediction. Further development is required to make the system suitable for use on patients.